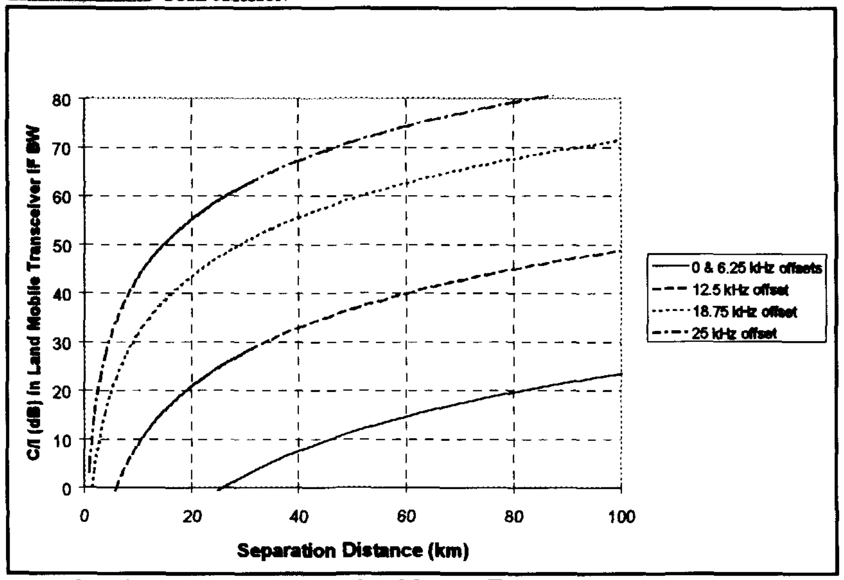


Figure 4-1. Interference from 9.6 kbps LEO One USA Transceiver into Land Mobile Transceiver

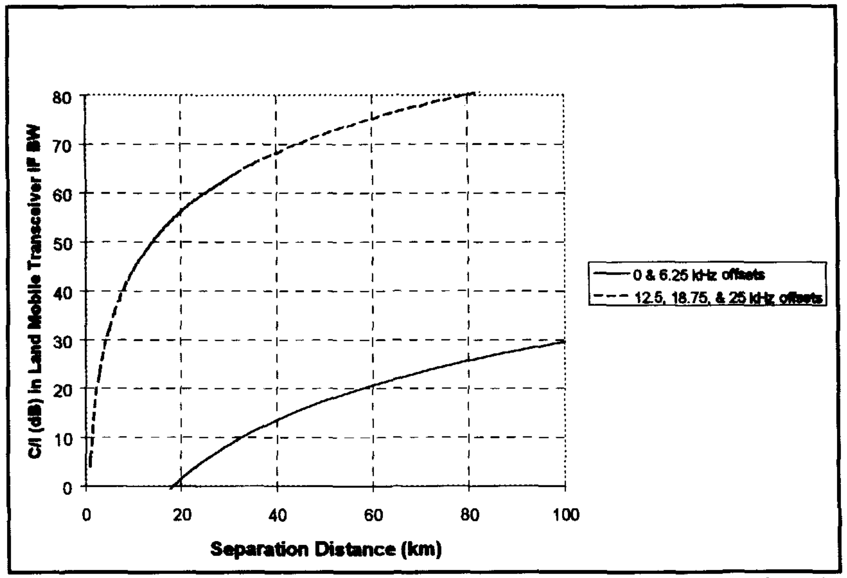


Figure 4-3. Interference from 2.4 kbps LEO One USA Transceiver into Land Mobile Transceiver

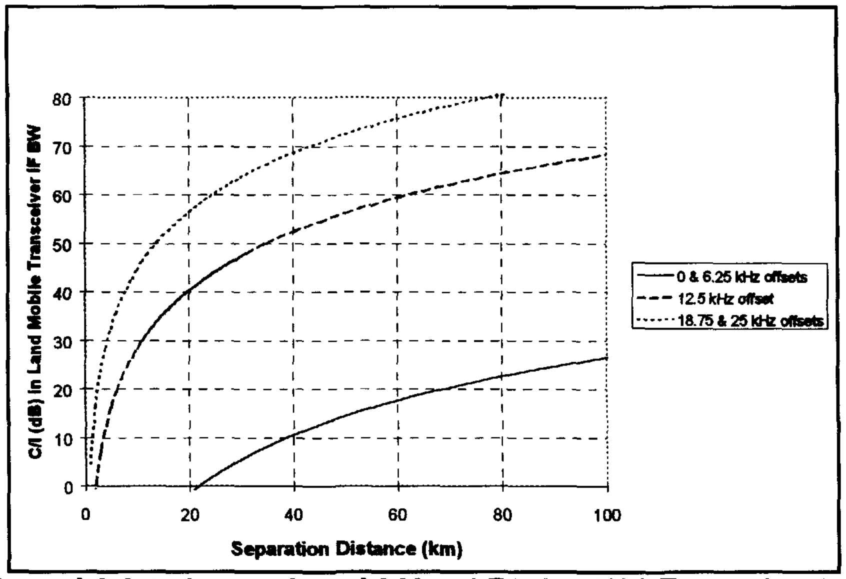


Figure 4-2. Interference from 4.8 kbps LEO One USA Transceiver into Land Mobile Transceiver

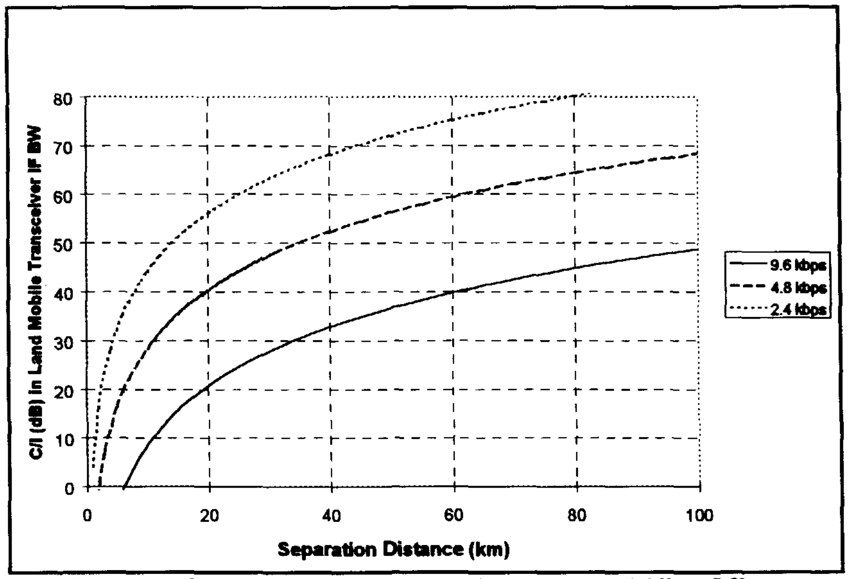


Figure 4-4. Interference Comparison for 12.5 KHz Offset

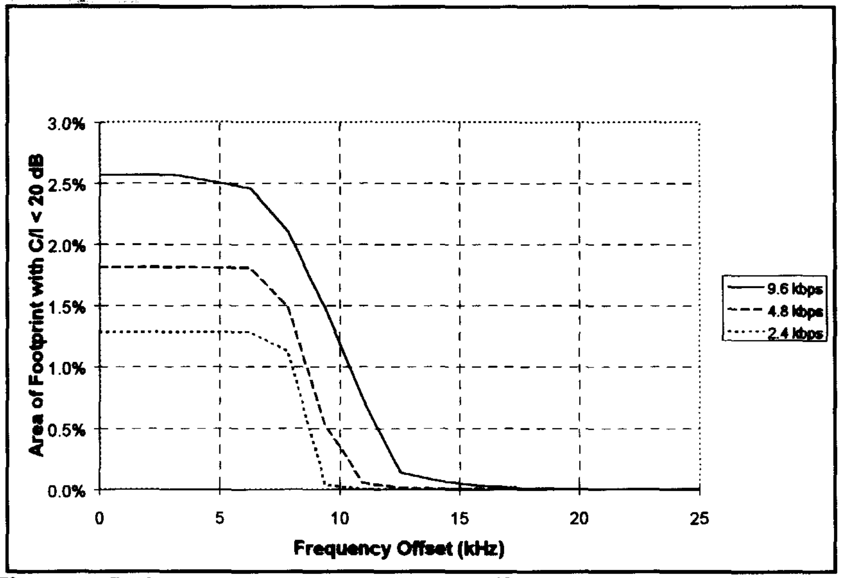


Figure 4-5. Interference Area Versus Offset For 15 Active LEO One USA Transceivers

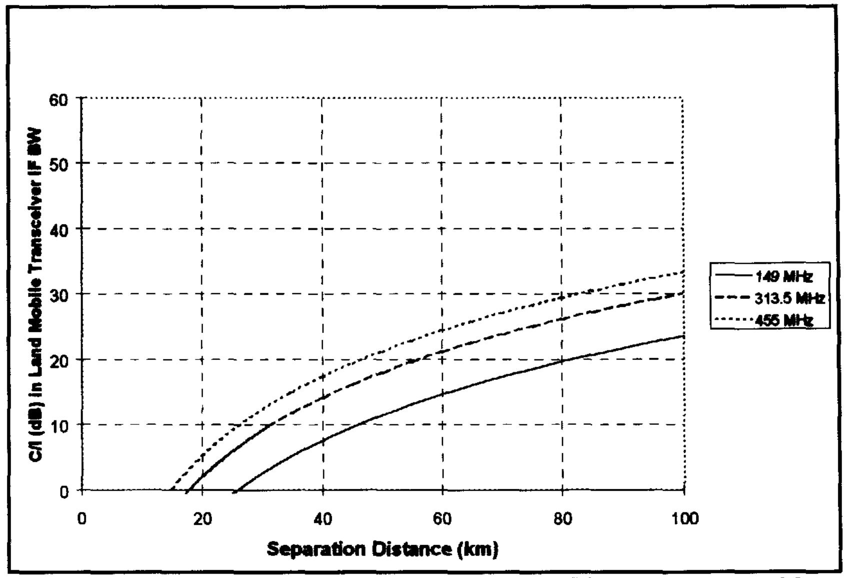


Figure 4-7. C/I as a Function of Separation Distance for 9.6 kbps LEO One USA Signal and 0 KHz Offset

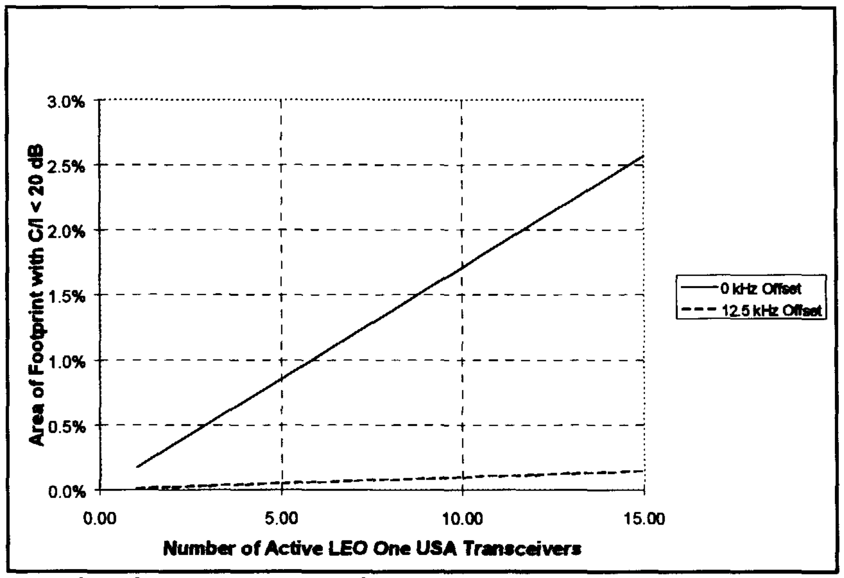


Figure 4-6. Interference Area Versus Number of Active 9.6 kbps LEO One USA Transceivers

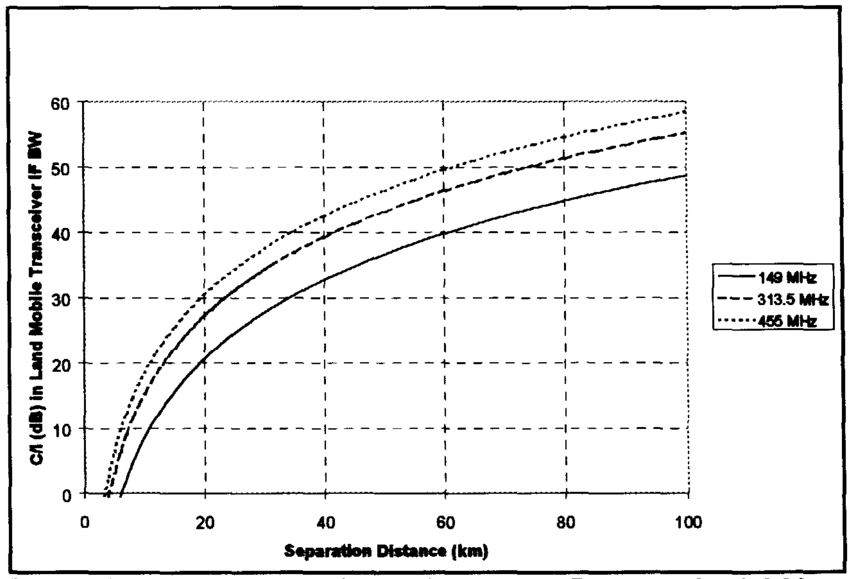


Figure 4-8. C/I as a Function of Separation Distance for 9.6 kbps LEO One USA Signal and 12.5 KHz Offset

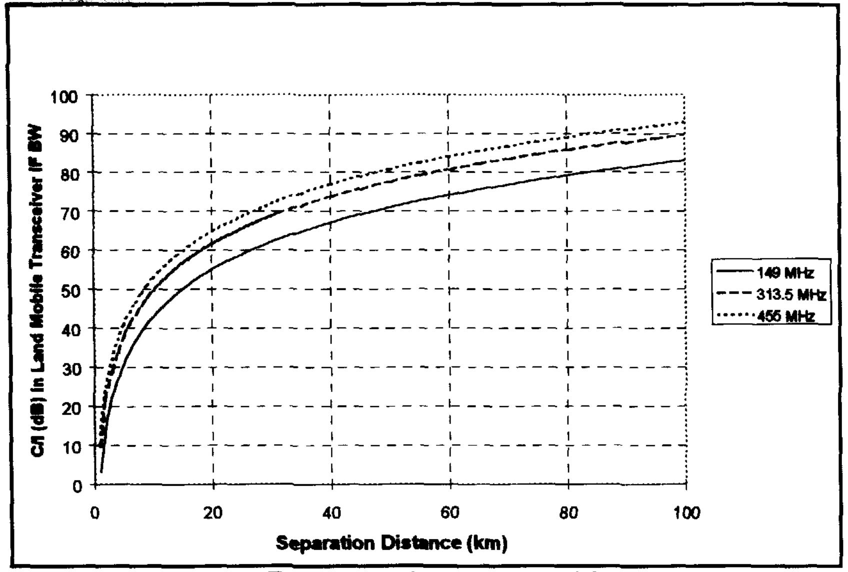


Figure 4-9. C/I as a Function of Separation Distance for 9.6 kbps LEO One USA Signal and 25 KHz Offset

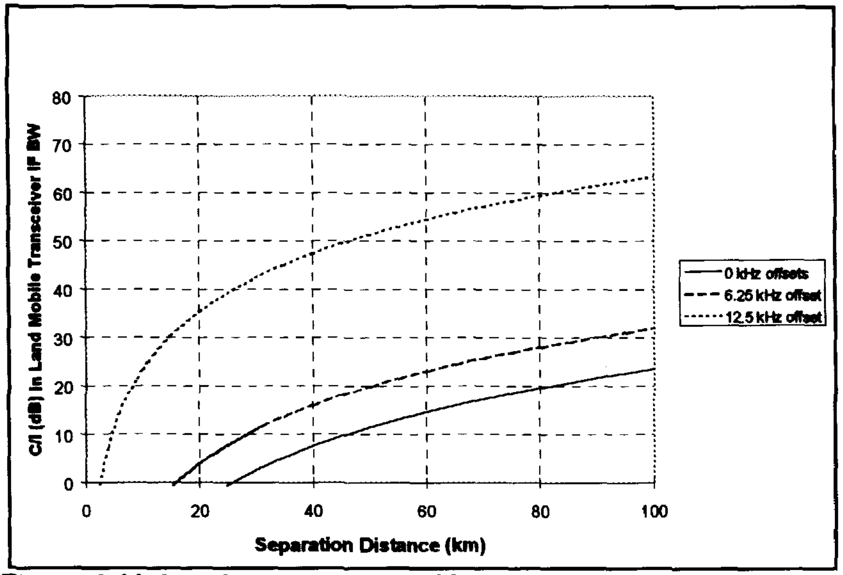


Figure 4-11. Interference from 9.6 kbps LEO One USA Transceiver into 8 kHz FM Land Mobile Transceiver

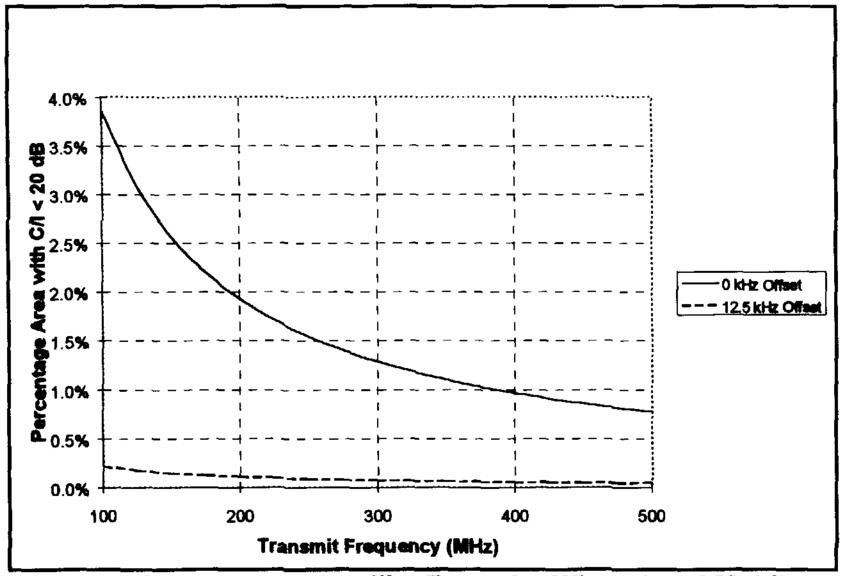


Figure 4-10. Area of Satellite Footprint Where Land Mobile Transceivers Experience Unacceptable Interference When 15 LEO One USA Transceivers are Operating at 9.6 kbps

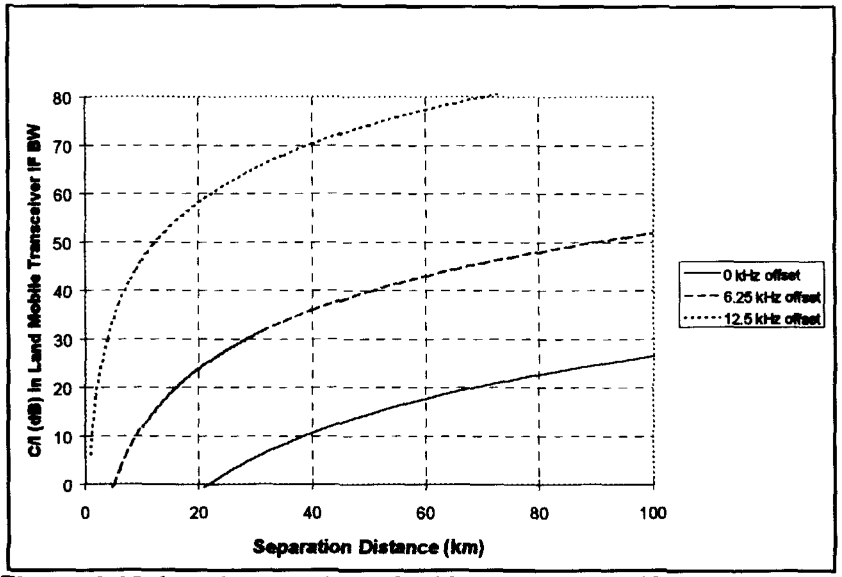


Figure 4-12. Interference from 4.8 kbps LEO One USA Transceiver into 8 kHz FM Land Mobile Transceiver

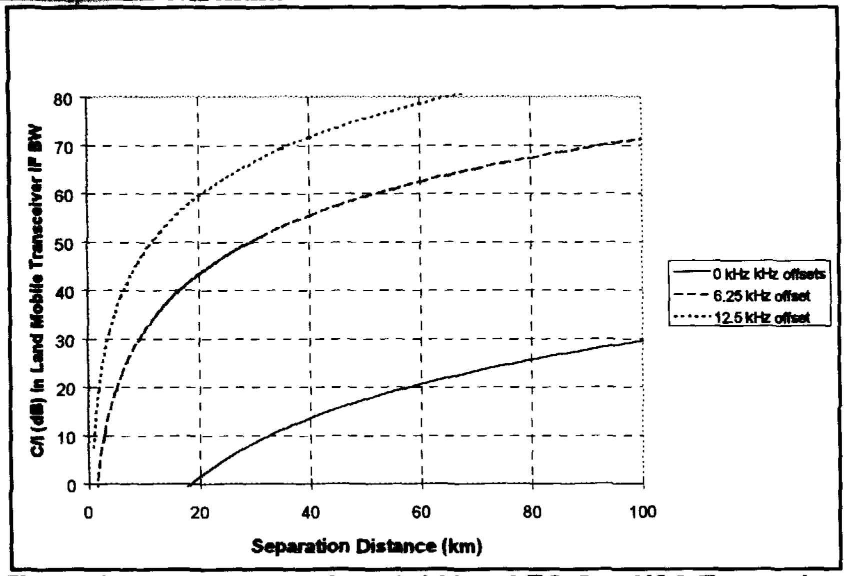


Figure 4-13. Interference from 2.4 kbps LEO One USA Transceiver into 8 kHz FM Land Mobile Transceiver

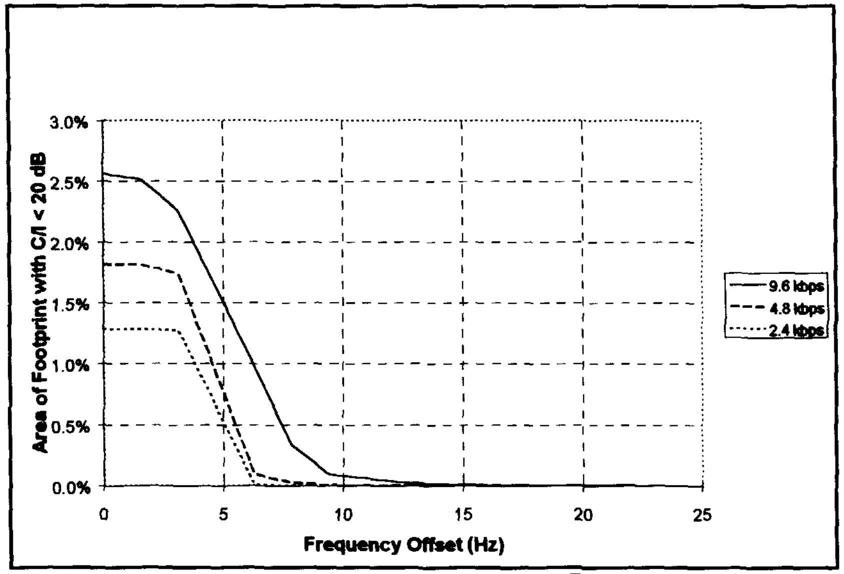


Figure 4-15. Interference Area Versus Offset For 15 Active LEO One USA Transceivers into 8 KHz FM Land Mobile Transceiver

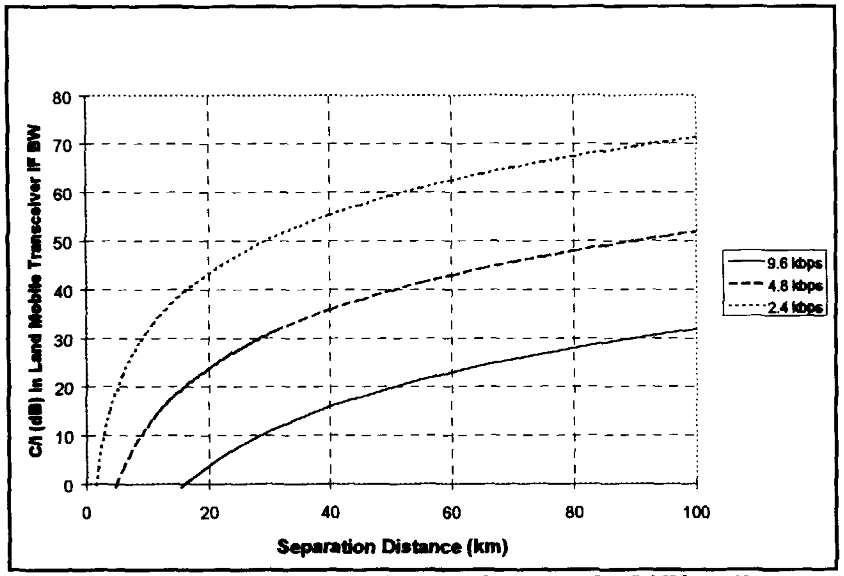


Figure 4-14. Interference Comparison for 6.25 KHz Offset

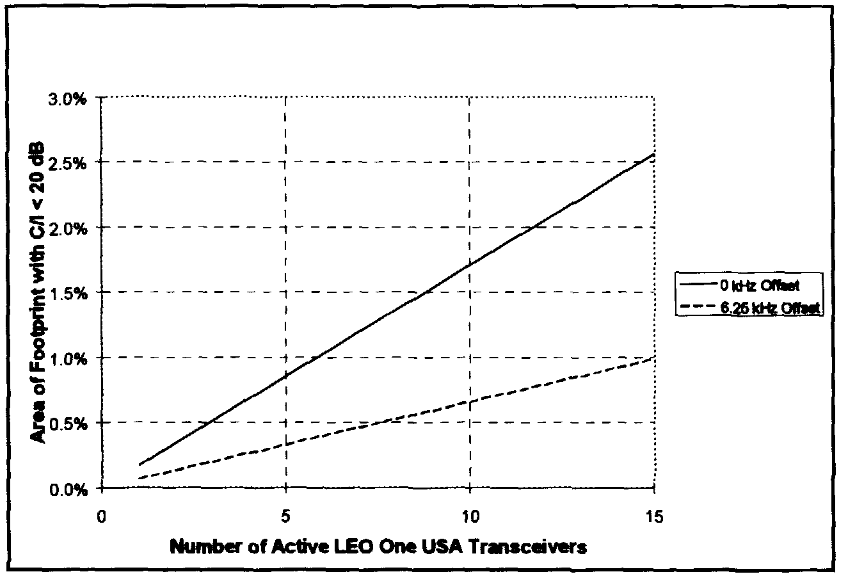


Figure 4-16. Interference Area Versus Number of Active 9.6 kbps LEO One USA Transceivers into 8 KHz FM Land Mobile Transceiver

LEO One USA

Downlink Band

Interference Analysis Report

Prepared by:

Mark A. Sturza
LEO One USA

Steve Kuh
Allan Uy
LinCom Corporation

12 April 1995

CORPORATION

CORPORATION

LEO One USA Downlink Band Interference Analysis Report

1.0 Introduction and Summary

LEO One USA proposes to operate its subscriber downlinks in the 137 - 138 MHz band. Other bands from 100 MHz to 500 MHz are also being considered for NVNG MSS downlinks. Unlike the uplink bands, where sharing with terrestrial services is possible, NVNG MSS systems generally cannot share their subscriber downlink spectrum with terrestrial services. Nearby terrestrial transmitters would jam the weak signals from far-off satellites. Thus, interference from intentional transmissions is not an issue.

In these bands, human-made noise typically sets the noise level for subscriber transceiver reception of the downlink signal. The dominant noise source is automotive noise, followed by noise from power-generating facilities, and then noise from industrial equipment. Other noise sources, such as consumer products, lighting systems, medical equipment, electrical trains, and buses are generally too low to be of concern.

This report investigates the human-made noise level at a single urban site in Los Angeles, California. Noise power measurements were made during a two day period in April 1995. The measurement setup is described in Section 2. On the first day, measurements were made from a second floor window overlooking a heavily trafficked street. On the second day, measurements were made at street level across a driveway from a busy parking structure. The window and street level results are provided in Sections 3 and 4, respectively.

Both sets of measurements showed that the human-made noise levels were similar in the three bands investigated (137 - 138 MHz, 387 - 390 MHz, and 400.15 - 406 MHz). The measurements made after evening rush hour showed a significant decrease in noise level. This tends to confirm that automotive noise is the dominant noise source.

The measurements made on the second day from street level were significantly higher then those made on the first day from the window. Possible explanations include the time-of-day (rush hour), the proximity to the parking structure (5 meters), and change in position relative to the power distribution lines.

In all cases (bands, time-of-day, and locations), the noise levels were within LEO One USA's link margin. LEO One USA's subscriber downlinks are designed with 21 dB of margin above kTB. Accounting for the median noise power above kTB would have allowed for from 2.3 to 17.2 dB of excess margin to combat fading, building penetration loss, and shadowing. A LEO One USA Transceiver would have been able to successfully receive the LEO One USA satellite downlink signal in all cases.

2.0 Measurement Setup

Figure 2-1 shows the test equipment configuration. Noise power measurements were made in 25 KHz bandwidth channels at several representative center frequencies in three potential "Little LEO" downlink bands as shown in Table 2-1.

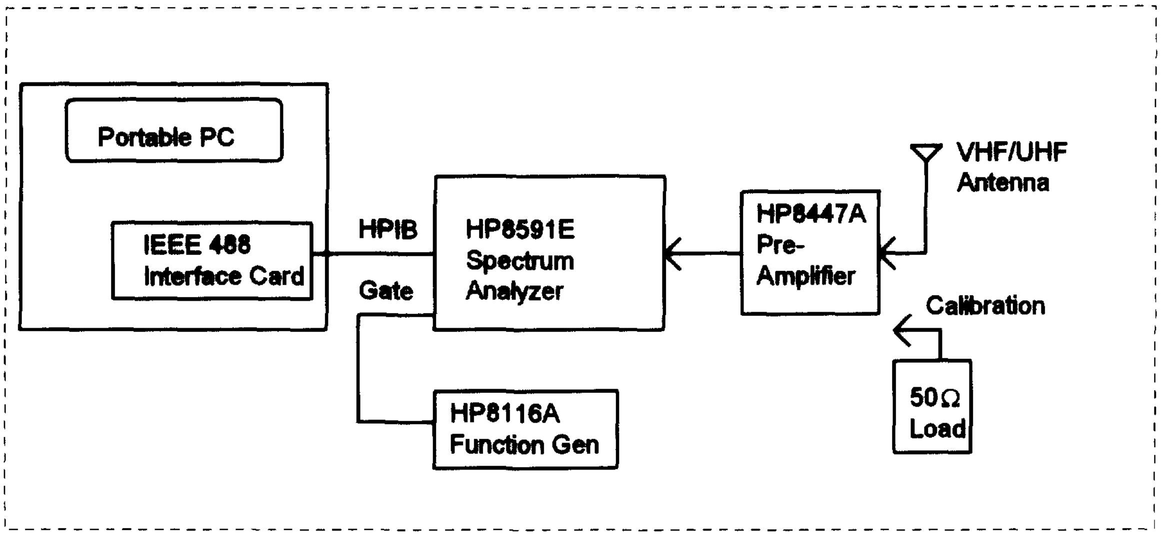


Figure 2-1. Test Equipment Configuration

Table 2-1. Representative Center Frequencies

Band	**Representative Center Frequencies**
137 - 138 MHz	137.0125, 137.4175, 137.4445, 137.4725 MHz
387 - 390 MHz	388.1, 388.75 MHz
400.15 - 406 MHz	401.11, 406.0 MHz

An HP 8591E spectrum analyzer with a time gating option was used to perform the interference power measurements. The instrument settings were as follows:

Frequency	: noted as above
Span	: 50 KHz
Sweep	: 300 msec
Resolution BW	: 1 KHz
Video BW	: 30 Hz
Trigger	: External
Gate Measurement	: Turn ON at LEVEL TRIGGER
Power Meter	: Power Measurement in 25 KHz BW utility

A 0.5 second gating signal, generated by a function generator, an HP8116A, was used to provide a burst window gating signal. The HP8447A preamplifier provides 7 dB noise figure, 20 dB gain, and has a 500 MHz bandwidth.

The measurement data collection was performed automatically using an IEEE 488 BUS, and the data was stored in a portable computer. The computer was used to monitor the spectrum analyzer's gated power measurements and collect 300 samples in each measurement set.

Prior to making the measurements, the noise floor of the preamplifier was calibrated. This was performed by installing a 50Ω load in place of the antenna at the input port of the HP8447A preamplifier. Three hundred samples were collected to measure the noise power of the preamplifier. All interference power measurements are presented in dB power relative to the preamplifier's calibrated noise floor.

The test equipment used is listed in Table 2-1.

Table 2-1. Equipment List

	Model No	**Option**	**Description**
1	HP8591E	105, 021	Spectrum Analyzer
2	5962-5023		HPIB Programming Manual
3	FA1443B		Antenna VHF/UHF Band
4	PCMCIA-GPIB		IEEE 488 Interface Card
5	776670-01		LabView Software for IEEE 488 Card
6	HP8116A		Function Generator
7			486-33 Toshiba Notebook PC
8	HP8447A		Pre Amp, NF = 7 dB

Measurements were taken at two locations: from a LinCom office window (tinted glass) and from in-front of the LinCom building. LinCom's office building is part of a complex located on the north-east corner of La Cienega and Slauson Boulevards in Los Angeles, California. The office window used for measurements is approximately 400 meters from busy La Cienega Boulevard. It is on a second floor and has a clear unobstructed view of the boulevard. There is a two story parking structure on the right side at about 75 meters from the office's window. There is also a three story office building at about 150 meters on the left side of the office's window. Measurements were also taken at street-level, outside of the LinCom building's front lobby, approximately 5 meters from the parking structure.

3.0 Measurement Results (LinCom Office Window)

Table 3-1 provides a summary of the measurement data taken at the LinCom window location. The median noise value above kTB is shown for each measurement set. The variation in noise power for the data collected in each set was small. Typically the difference between the 10-th and the 90-th percentile values was less then 2 dB. Plots of the cumulative probability of exceeding kTB for each of the measurement sets are shown in the indicated figures.

The noise power levels for each of the potential "Little-LEO" bands is similar. The data corresponding to evening hours show a significant decrease from the other measurements made during the day.

Table 3-1. Summary of Measurements Taken in LinCom Office

Figure	Freq [MHz]	Date	Time	Median Value Above kTB [dB]
3-1	137.0125	Apr 10	10:10 am	11.4
3-9	137.0125	Apr 10	1:52 pm	6.0
3-17	137.0125	Apr 10	4:28 pm	5.8
3-25	137.0125	Apr 10	8:05 pm	4.2
3-2	137.4175	Apr 10	10:23 am	6.8
3-10	137.4175	Apr 10	3:32 pm	8.0
3-18	137.4175	Apr 10	4:34 pm	8.5
3-26	137.4175	Apr 10	8:10 pm	4.0
3-3	137.4445	Apr 10	10:30 am	8.0
3-11	137.4445	Apr 10	3:38 pm	6.7
3-19	137.4445	Apr 10	4:41 pm	8.5
3-27	137.4445	Apr 10	8:15 pm	3.8
3-4	137.4725	Apr 10	10:37 am	7.2
3-12	137.4725	Apr 10	2:10 pm	7.7
3-20	137.4725	Apr 10	4:46 pm	8.6
3-28	137.4725	Apr 10	8:20 pm	4.0
3-5	388.1	Apr 10	11:11 am	16.1
3-13	388.1	Apr 10	2:16 pm	12.4
3-21	388.1	Apr 10	4:52 pm	11.5
3-29	388.1	Apr 10	8:25 pm	8.3
3-6	388.75	Apr 10	11:55 am	9.7
3-14	388.75	Apr 10	2:22 pm	11.4
3-22	388.75	Apr 10	4:57 pm	10.8
3-30	388.75	Apr 10	8:30 pm	8.7
3-7	401.11	Apr 10	1:32 pm	11.8
3-15	401.11	Apr 10	2:29 pm	10.6
3-23	401.11	Apr 10	5:03 pm	15.9
3-31	401.11	Apr 10	8:35 pm	10.4
3-8	406.0	Apr 10	12:20 pm	7.7
3-16	406.0	Apr 10	2:35 pm	10.0
3-24	406.0	Apr 10	5:09 pm	8.7
3-32	406.0	Apr 10	8:40 pm	8.2

4.0 Measurement Results (In Front of LinCom Building)

Table 3-1 provides a summary of the measurement data taken in front of the LinCom building. The median noise power value above kTB is shown for each measurement set. The variation in noise power for the data collected in each set was small. Typically the difference between the 10-th and the 90-th percentile values was less then 2 dB. Plots of the cumulative probability of exceeding kTB for each of the measurement sets are shown in the indicated figures.

The noise power levels for each of the potential "Little-LEO" bands are similar. The measurements show a significant increase compared to those taken from the LinCom window. Further investigation is required to determine the source of this additional noise. Possibilities include the proximity of the parking structure, that the measurements were made during rush hour, and the relative location of power distribution lines.

Table 4-1. Summary of Measurements Taken in Front of LinCom Building

Figure	Freq [MHz]	Date	Time	Median Value Above kTB [dB]
4-1	137.0125	Apr 11	5:03 pm	15.5
4-2	137.4175	Apr 11	5:21 pm	17.2
4-3	137.4445	Apr 11	5:26 pm	17.1
4-4	137.4725	Apr 11	5:31 pm	17.2
4-5	388.1	Apr 11	5:36 pm	18.7
4-6	388.75	Apr 11	5:41 pm	17.4
4-7	401.11	Apr 11	5:46 pm	17.7
4-8	406.0	Apr 11	5:51 pm	14.1

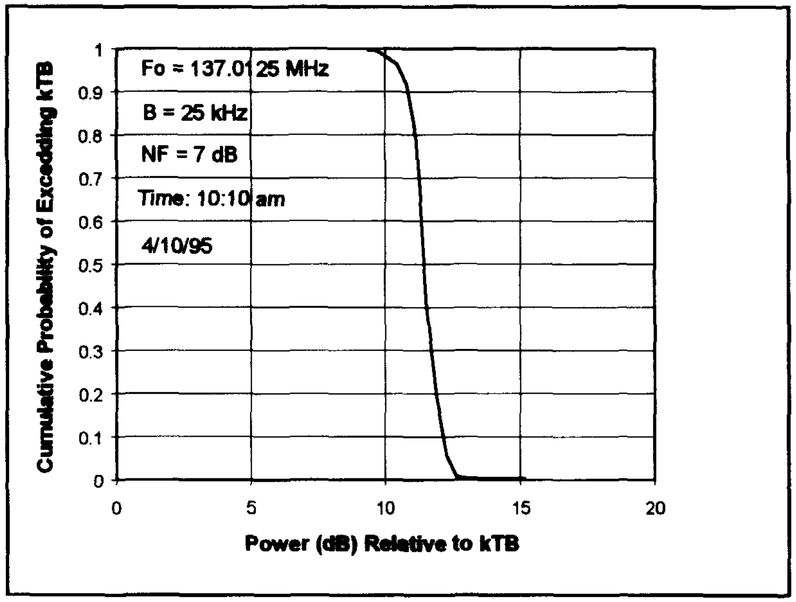
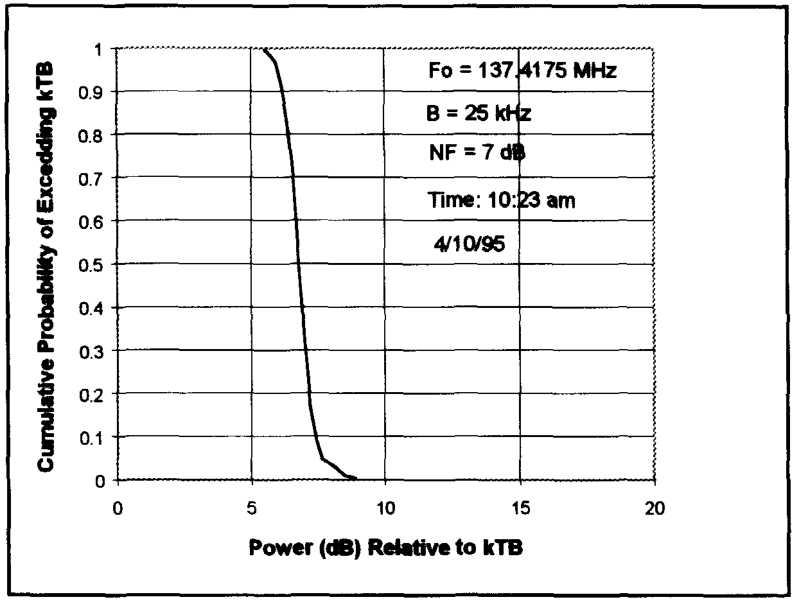


Figure 3-1



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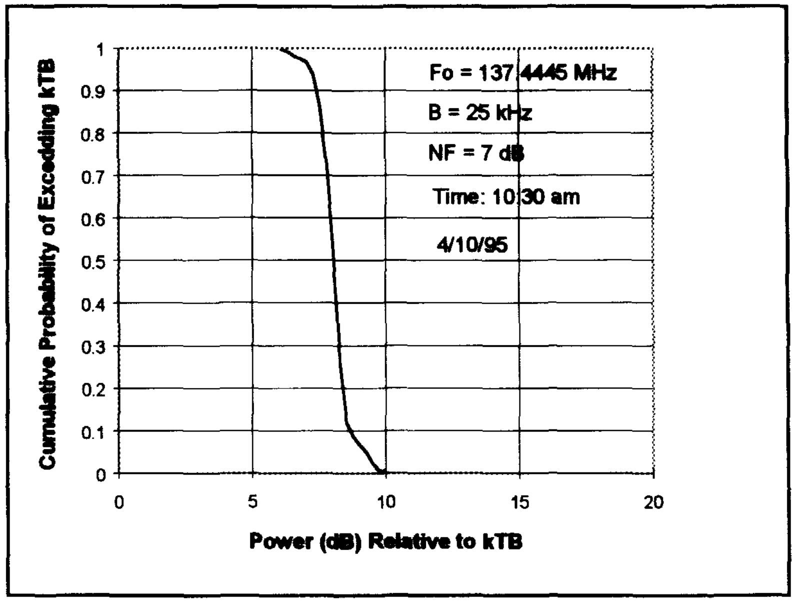

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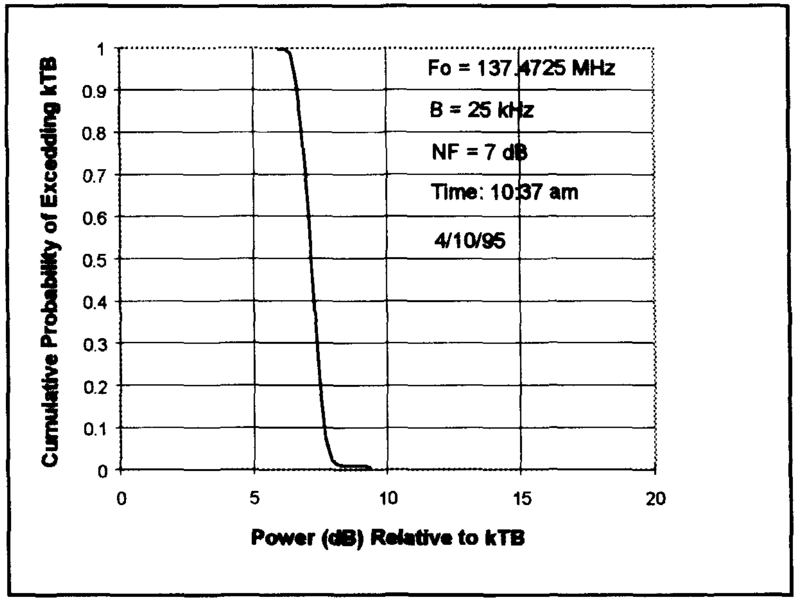

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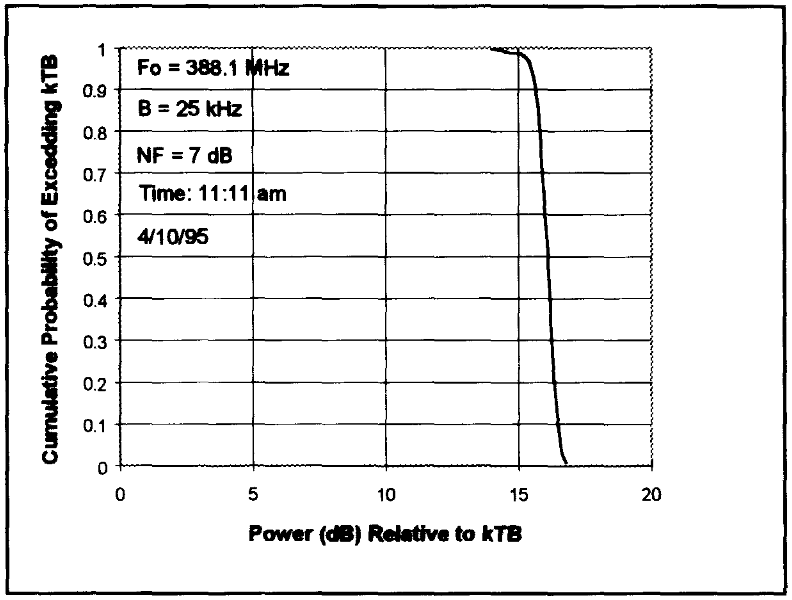

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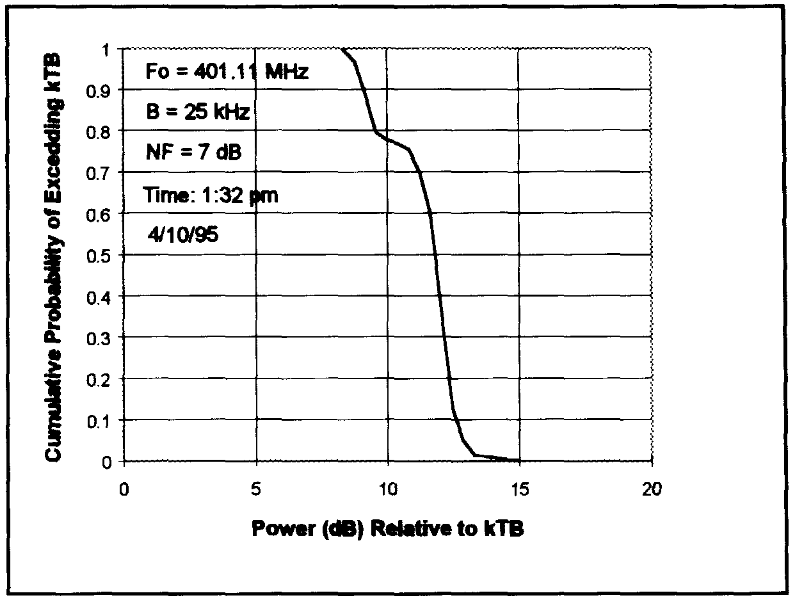

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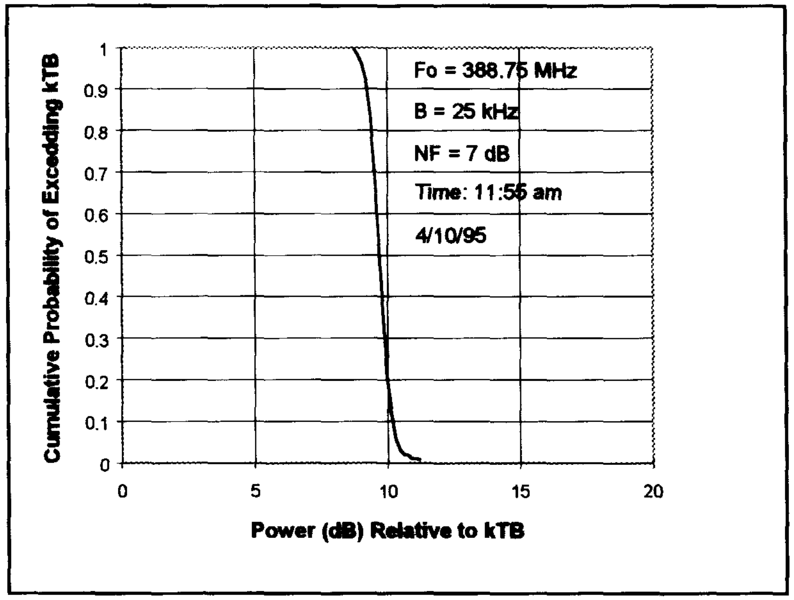

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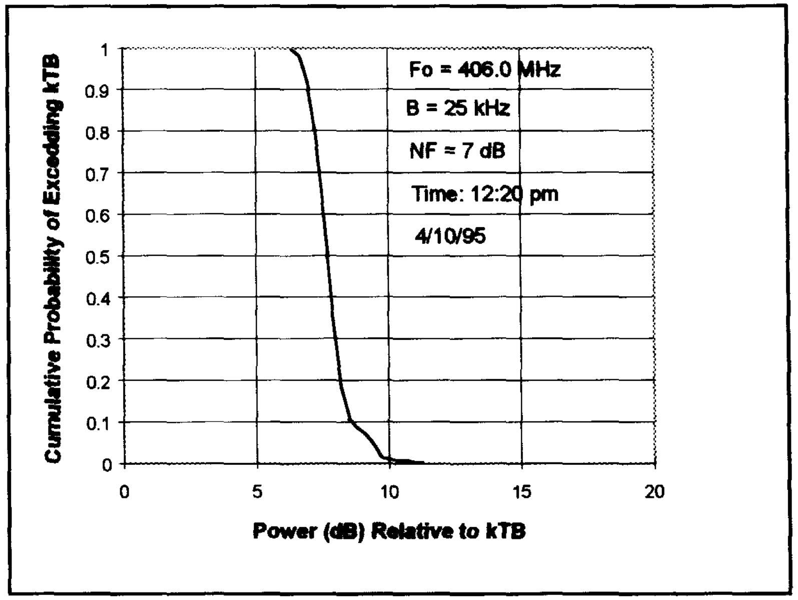

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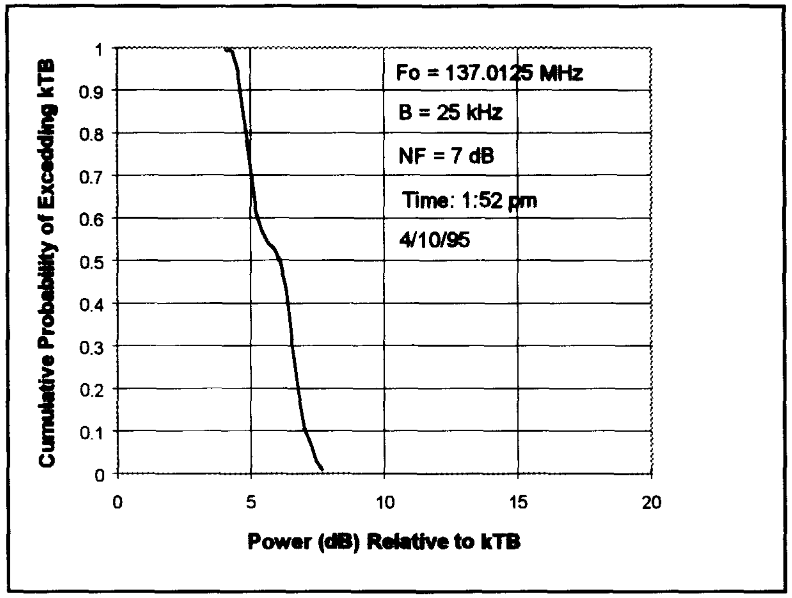

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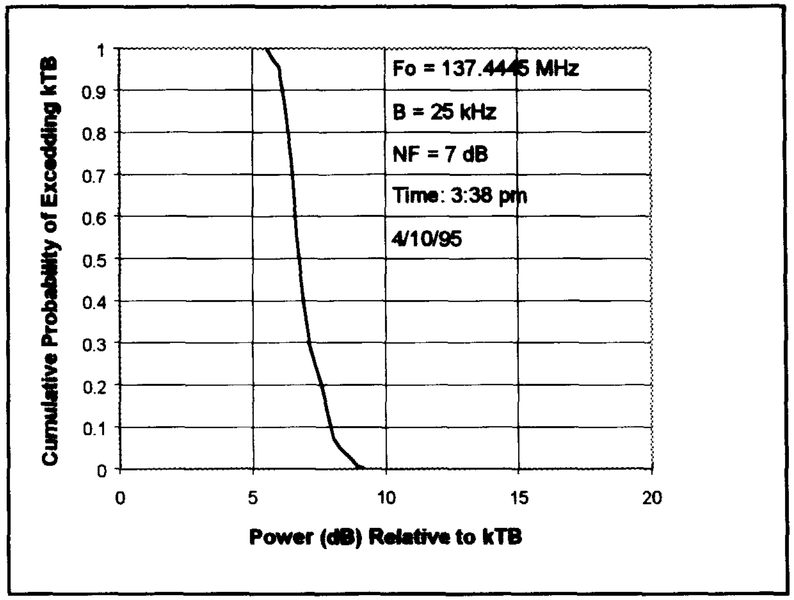

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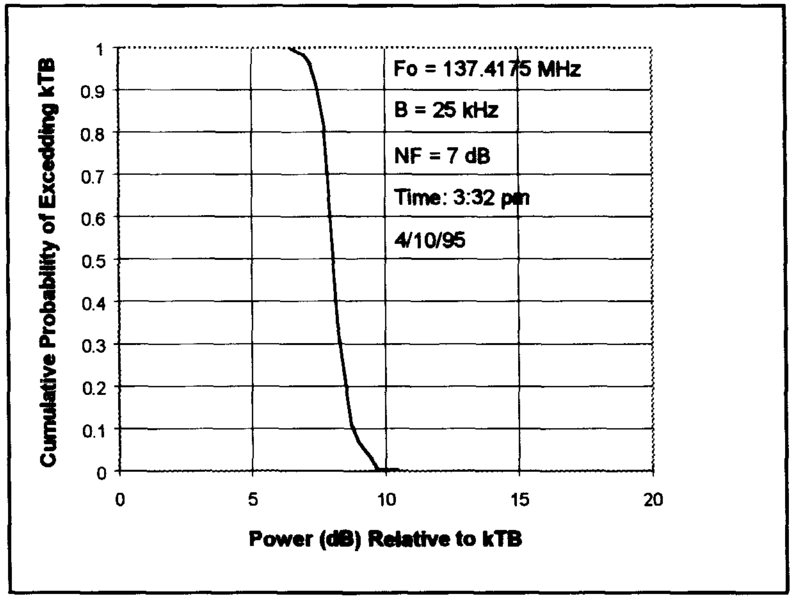

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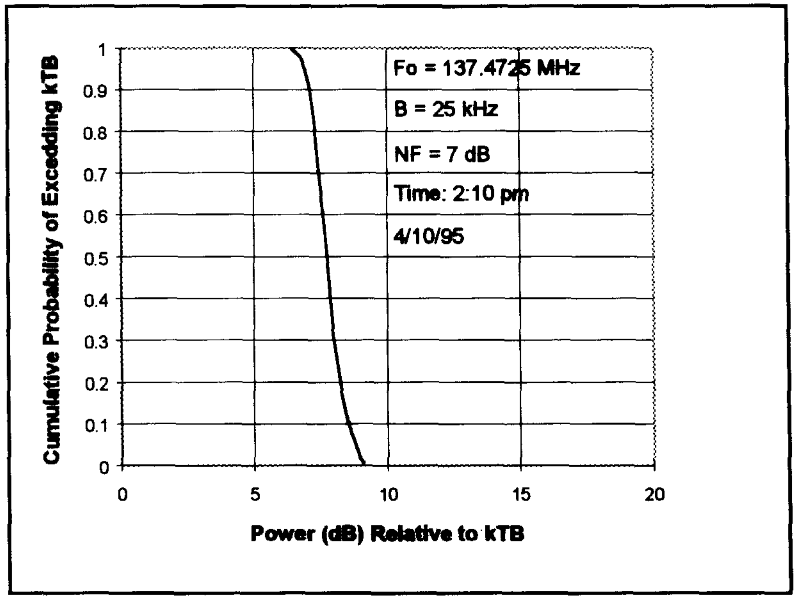

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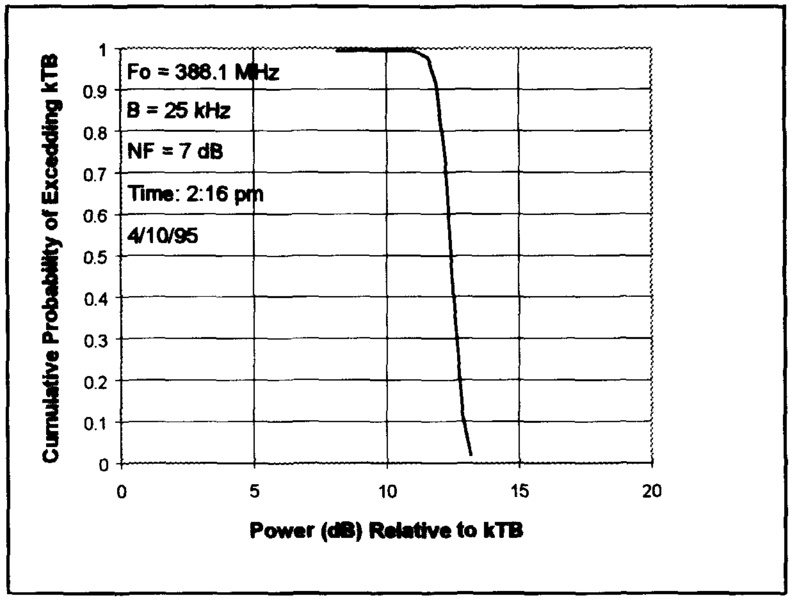

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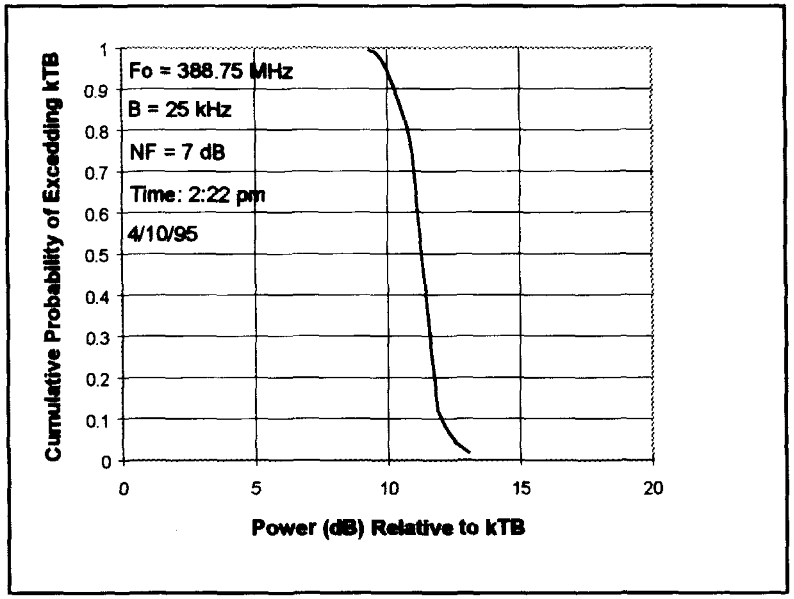

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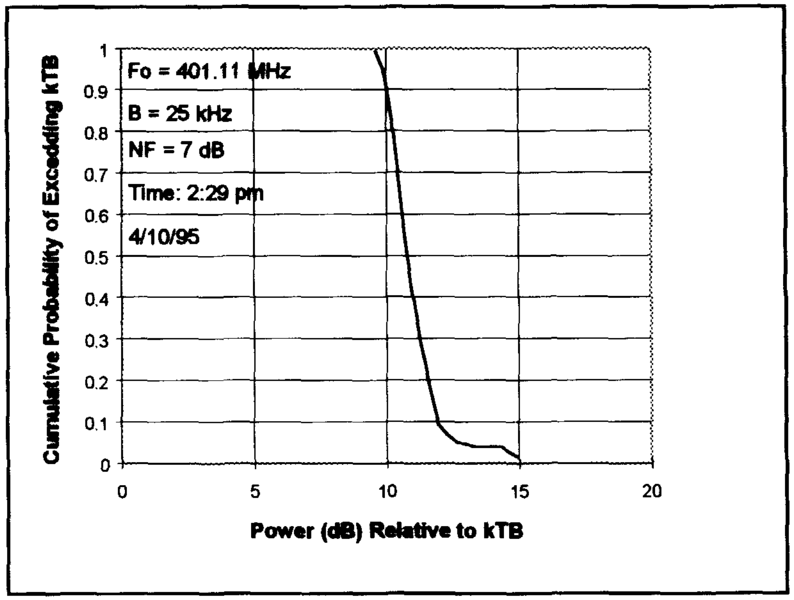

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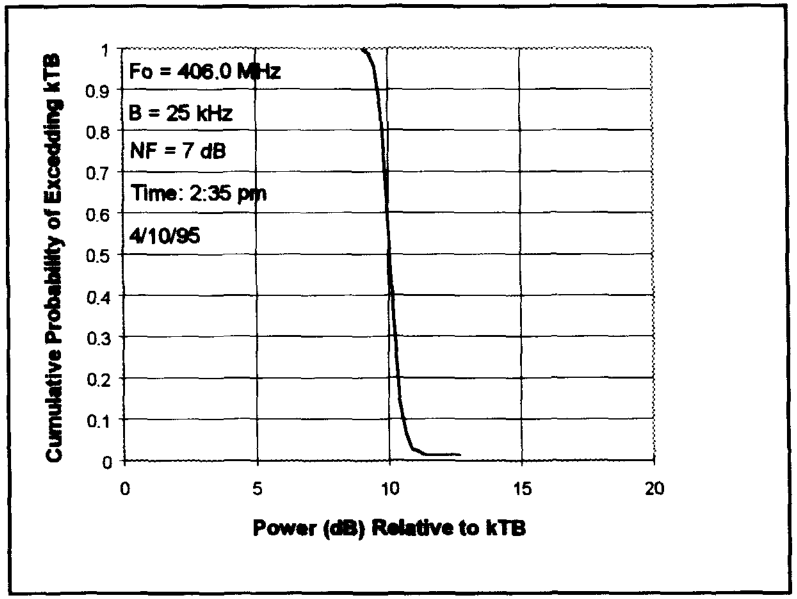

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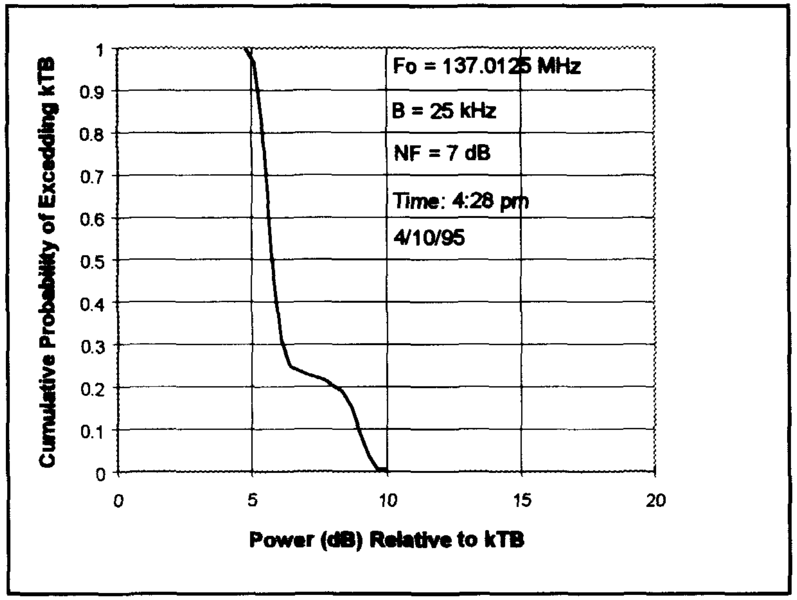

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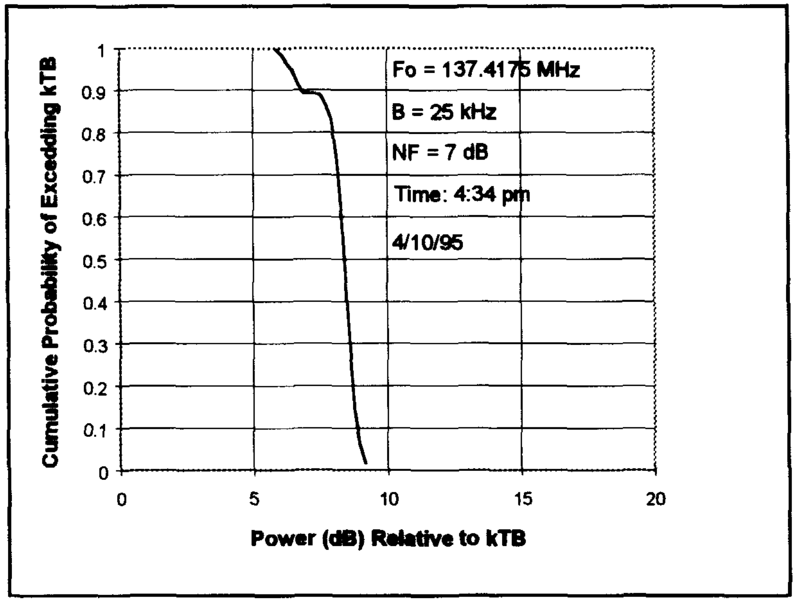

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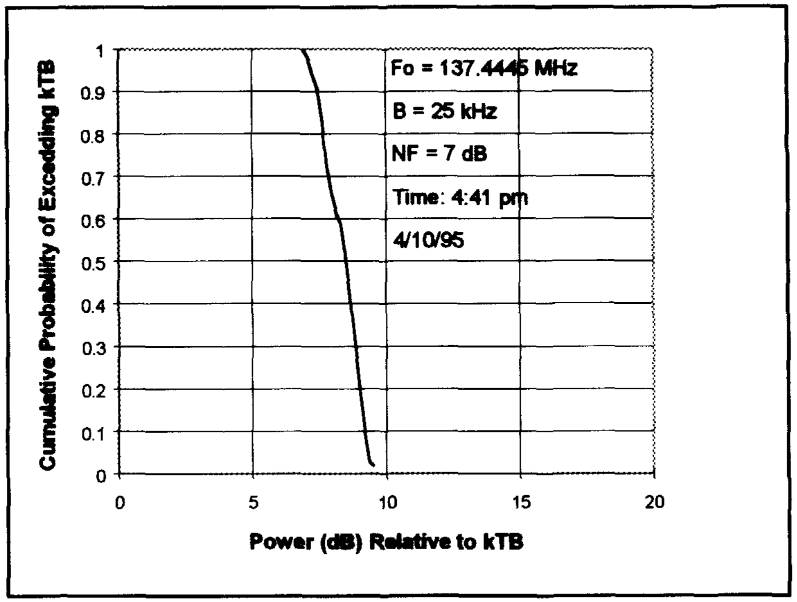

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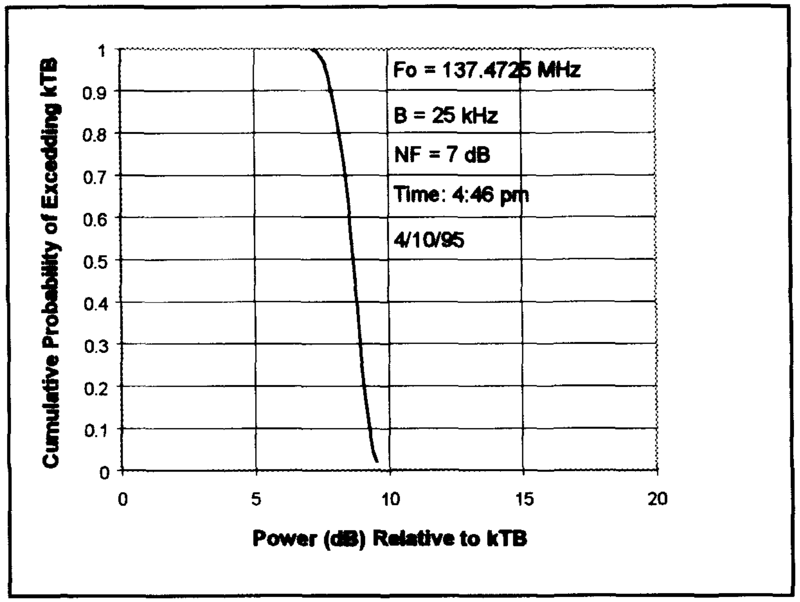

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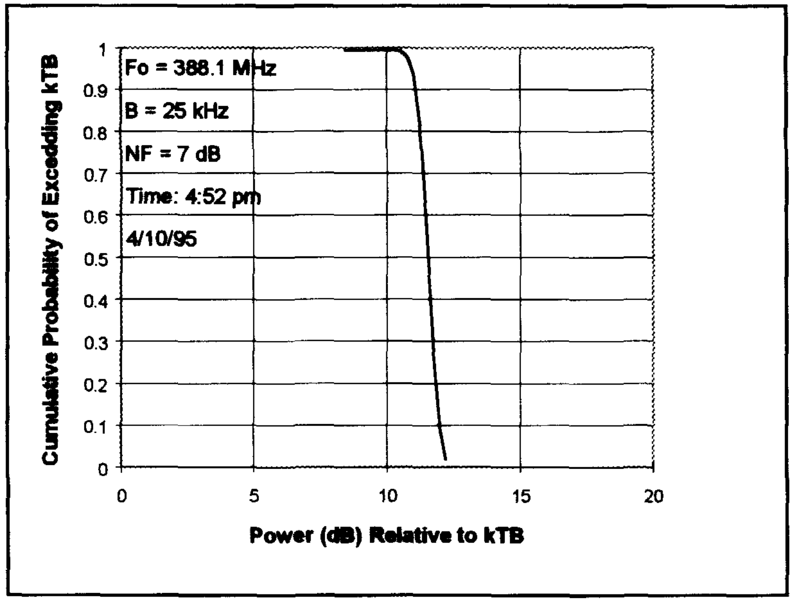

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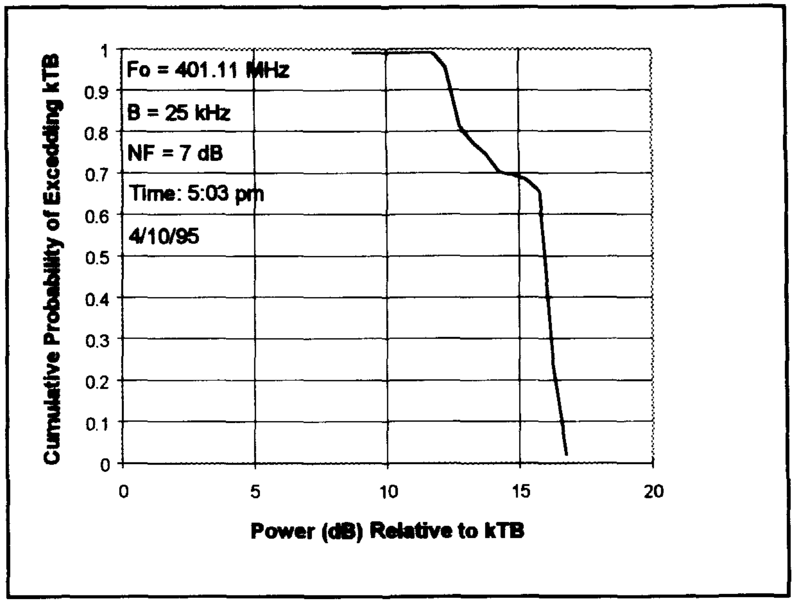

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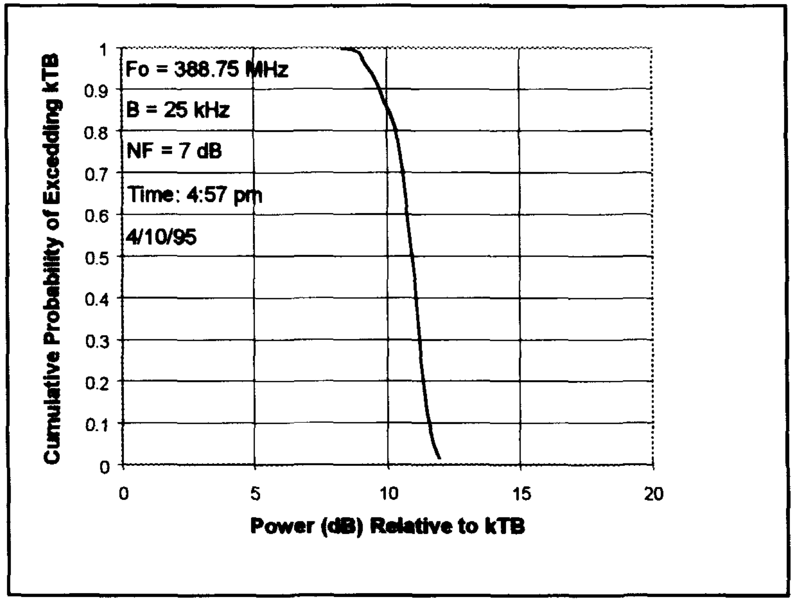

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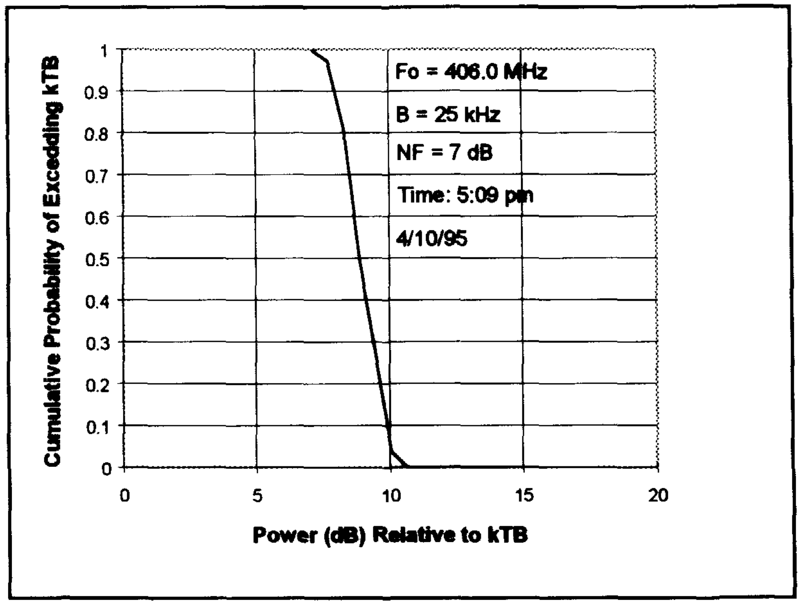

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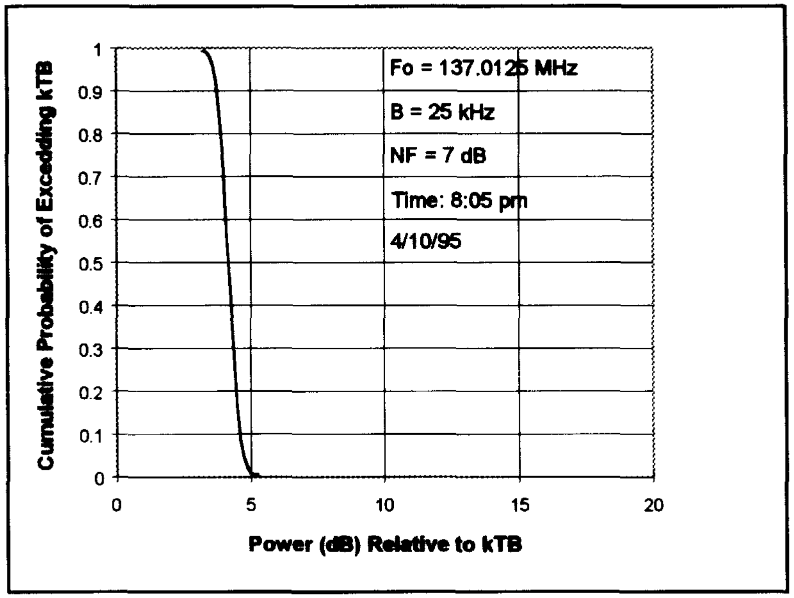

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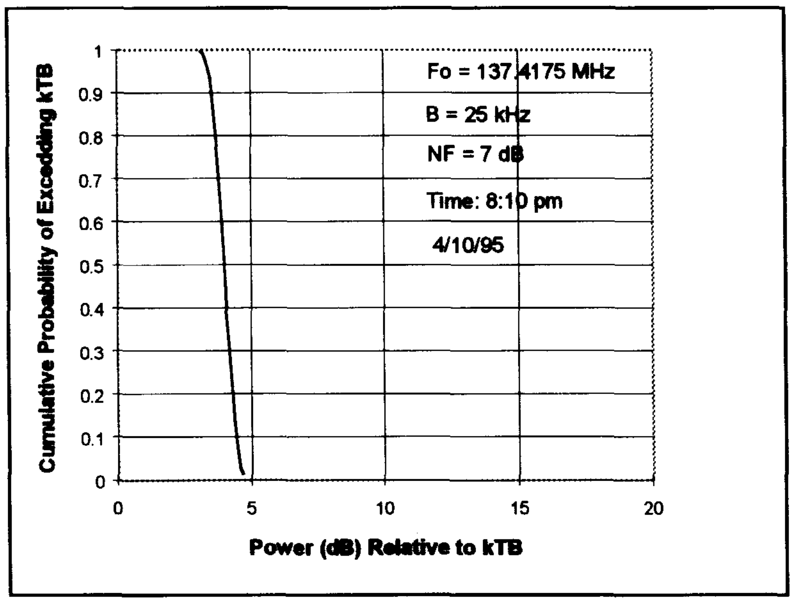

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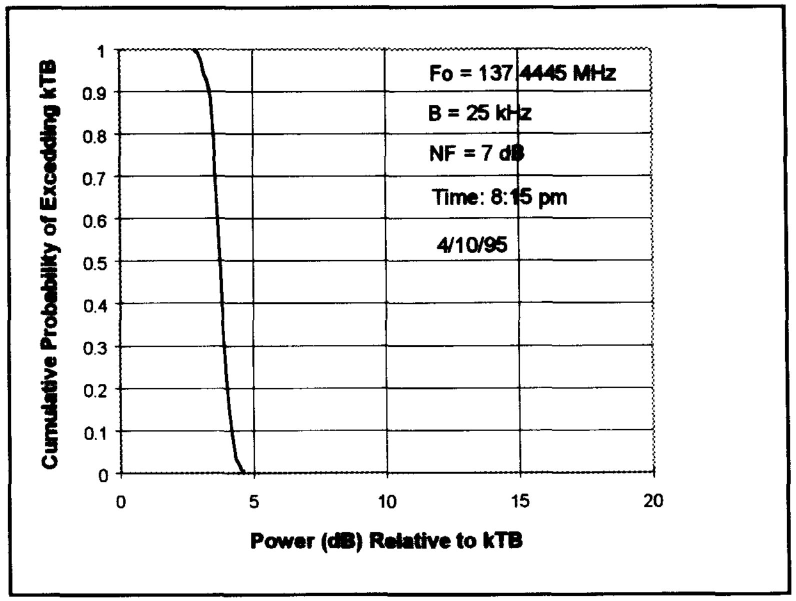

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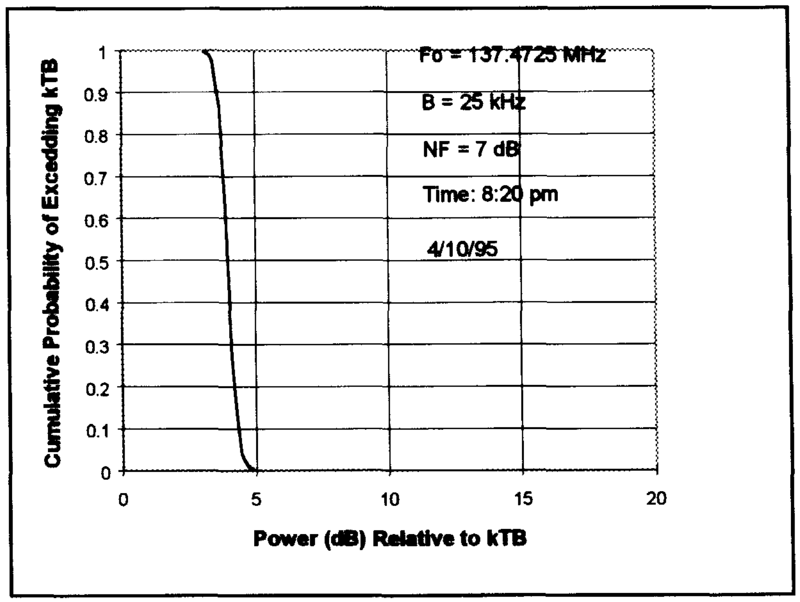

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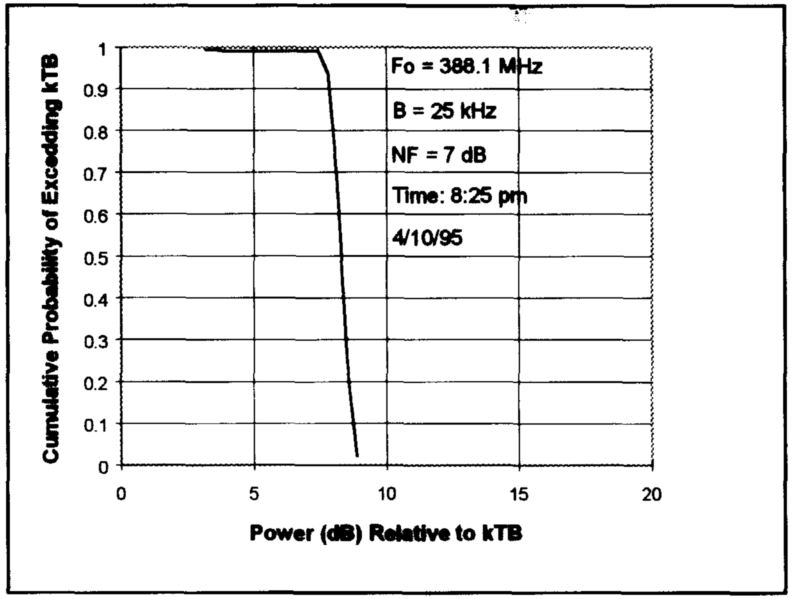
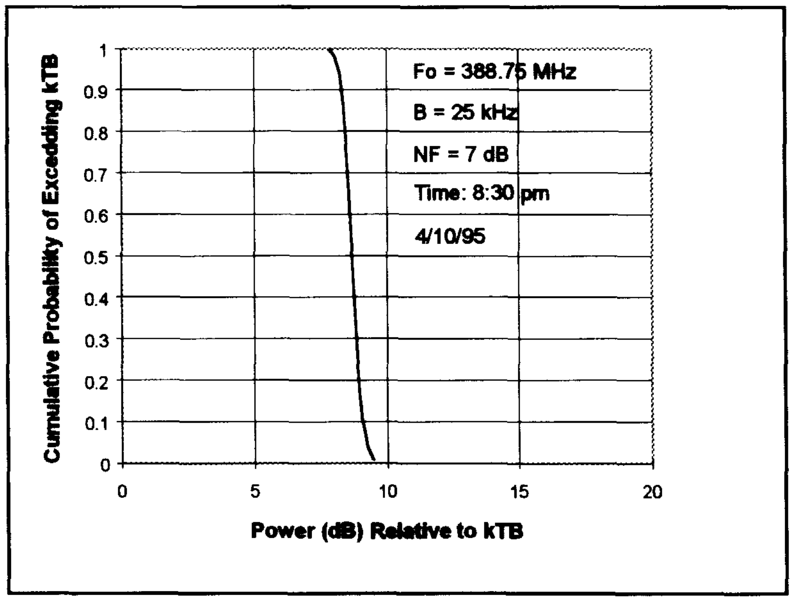


Figure 3-29



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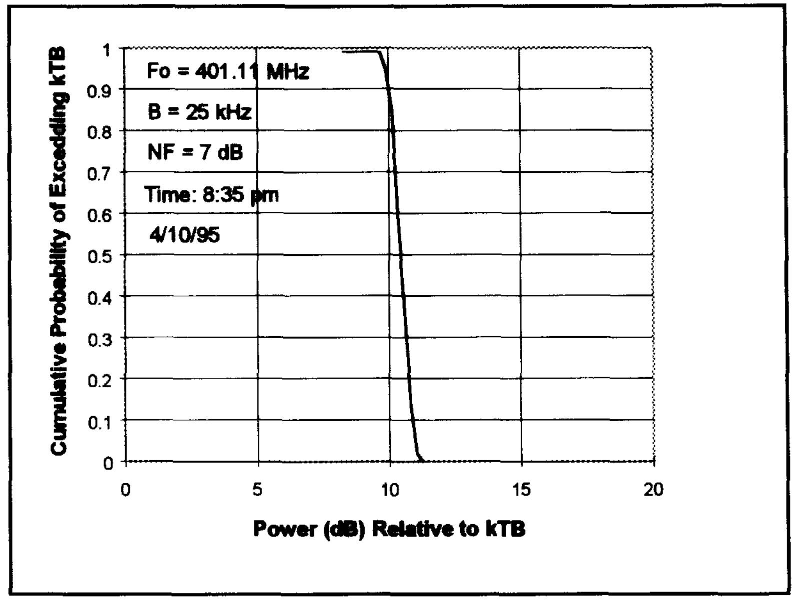

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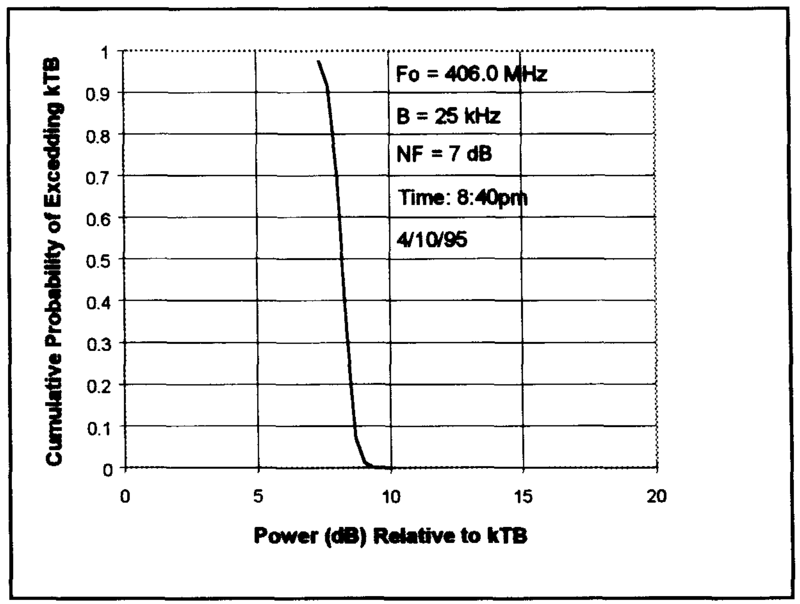

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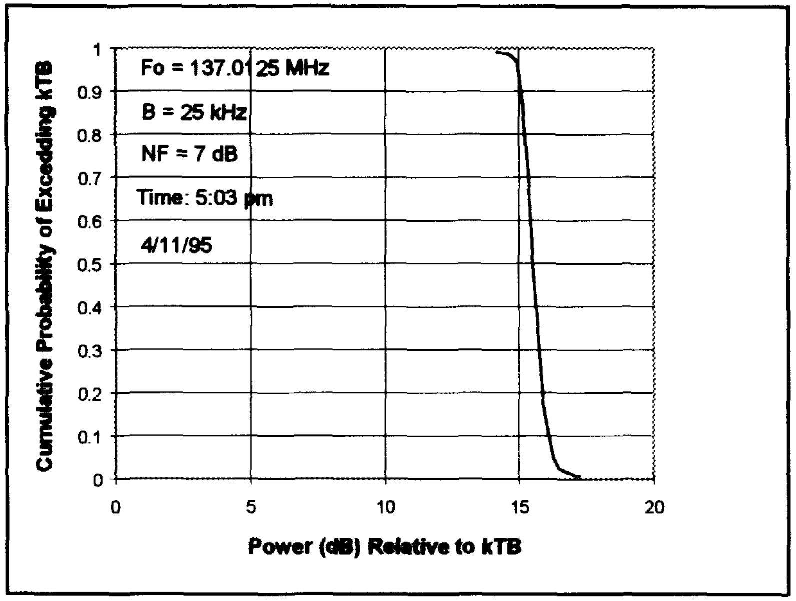

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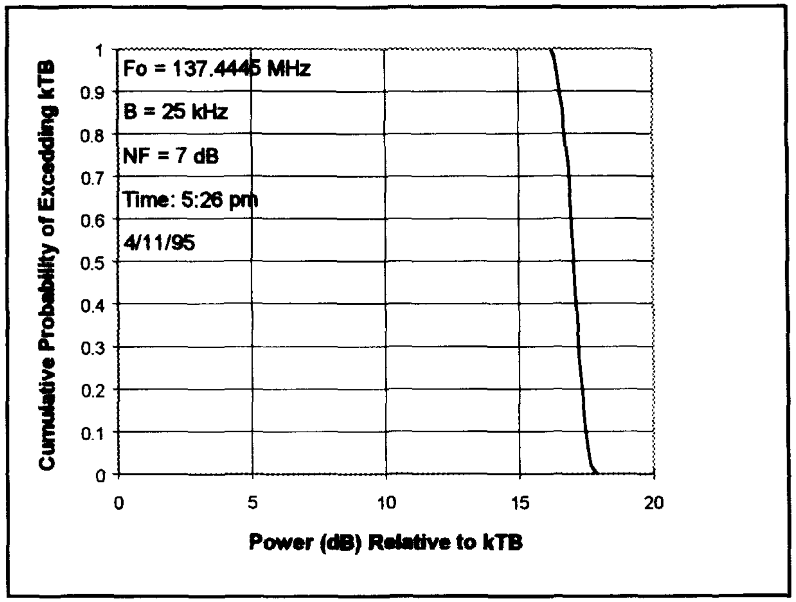


Figure 4-3

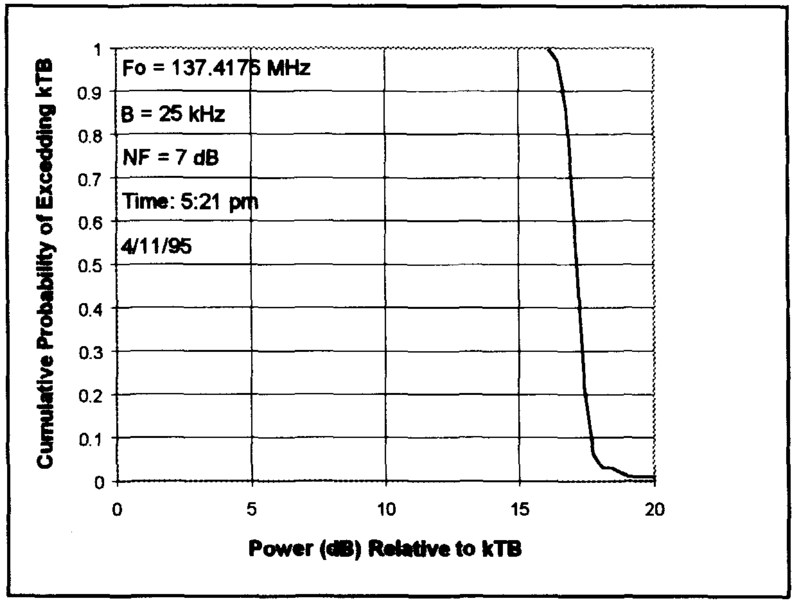
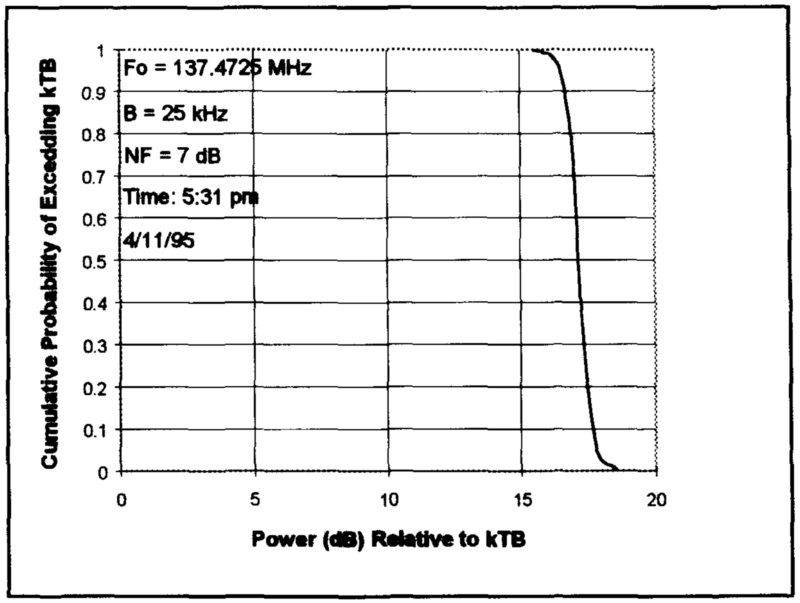


Figure 4-2



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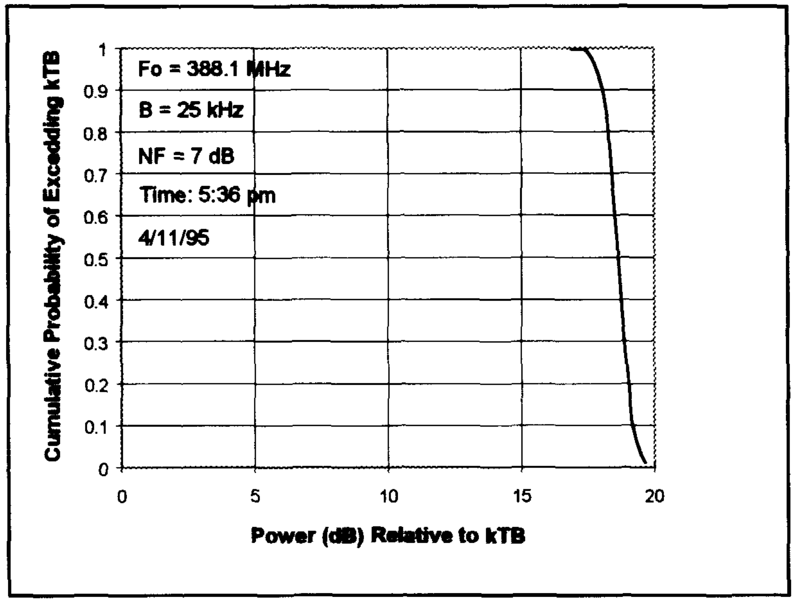
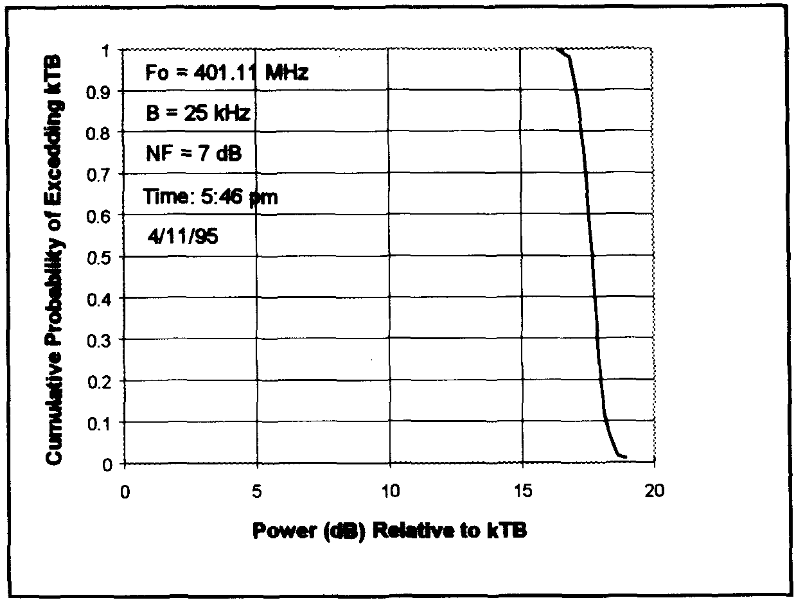


Figure 4-5



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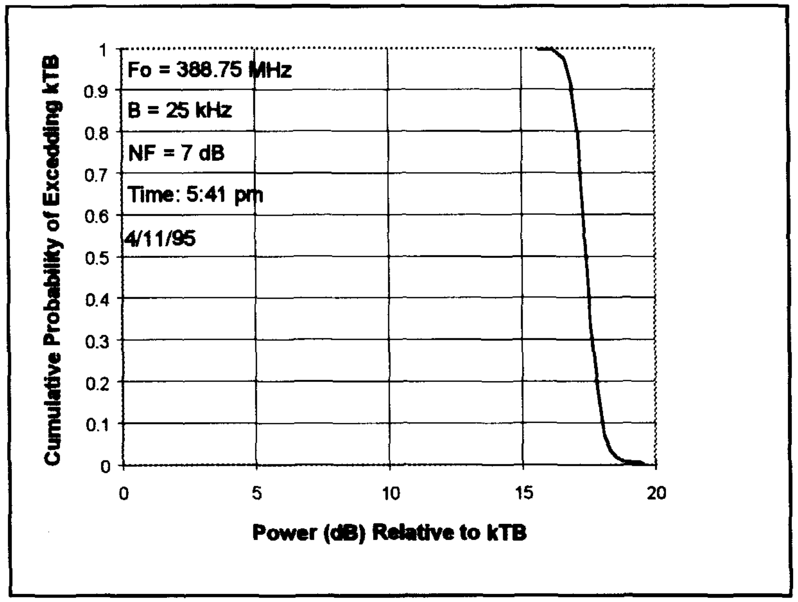

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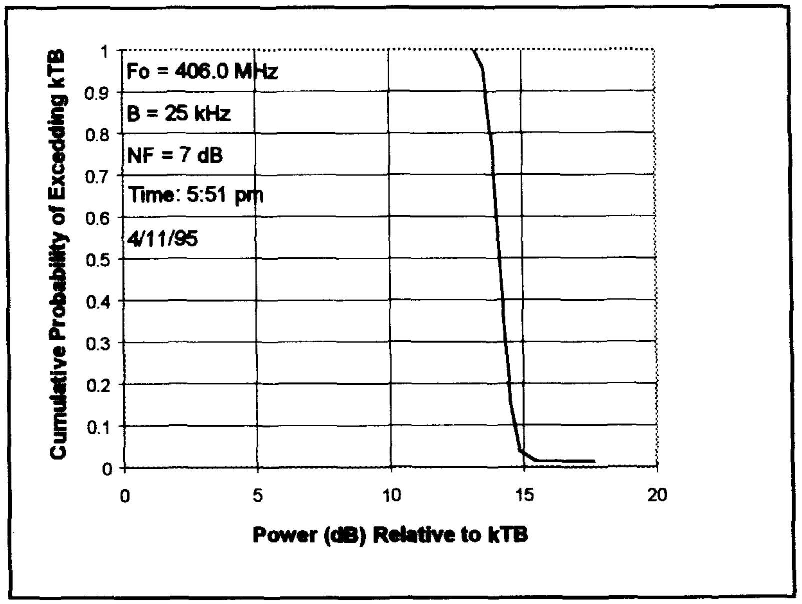

Figure 4-8

CERTIFICATE OF SERVICE

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